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FOREST SURVEY RELEASE NO. 2

SEPTEMBER 1, 1939

FOREST RESOURCES OF THE
PIEDMONT REGION OF SOUTH CAROLINA

A progress report

by

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U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

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P R E F A C E

Through the McSweeney-McNary Forest Research Act of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the research branch of the United States Forest Service to carry out the provisions of the Act, and each regional forest experiment station was made responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station at Asheville, North Carolina.

The work of the Survey is divided into five major phases:

1. Inventory. The extent, location, and condition of forest lands, and the species, quantity, and quality of the timber on these lands.
2. Growth. The current and probable future productivity of forest areas.
3. Drain. The amount of timber cut for industrial and domestic use, and the loss from fire, insects, disease, suppression, and other causes.
4. Requirements. The present and probable future trend in the requirements for forest products by all classes of consumers.
5. Policies and Programs. Analysis of the relation of these findings to one another and to other economic factors as a basis in formulating public and private policies and programs of forest land use and management.

This progress report presents preliminary information on the first three of these phases for the Piedmont region (unit no. 3) of South Carolina, one of the three Forest Survey units into which the state has been divided. Similar releases have been prepared for the other two units, the Northern Coastal Plain and the Southern Coastal Plain. A report for the state as a whole will be published later.

Information on the forest resources of the Piedmont region was obtained through a field examination of sample plots during the fall of 1936. A total of 8,389 quarter-acre plots were established at intervals of one-eighth of a mile on compass lines 10 miles apart, extending across the unit from southwest to northeast. The data recorded for these sample plots were treated as a statistical sample of the entire unit. Consequently, small tabular items have a high probability of error and should

be considered as indicating only relative magnitudes.

The figures on consumption of forest products for industrial and domestic purposes were obtained by canvassing all primary wood-using industries and a number of representative domestic consumers.

Acknowledgment is made to the Forest Survey staff of the Southern Forest Experiment Station for assistance in assembling the data for this release; and to the Regional Forester, Southern Region, U. S. Forest Service, and to Mr. H. A. Smith, State Forester of South Carolina, for review of the manuscript.

Additional copies of this report and copies of forthcoming releases may be obtained by writing to the Director, Appalachian Forest Experiment Station, Asheville, N. C.

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FOREST RESOURCES OF THE PIEDMONT REGION
OF SOUTH CAROLINA

GENERAL ECONOMY OF THE REGION

The western third of South Carolina, comprising 18 counties, has been designated by the Forest Survey as the Piedmont unit (fig. 1). This unit covers 6,672,600 acres, and corresponds, as closely as county lines permit, with the Piedmont region of the state. It contains 42 percent of the state's agricultural land, 30 percent of the forest land, and 44 percent of the inhabitants.

The Piedmont unit of South Carolina is one of the more highly industrialized regions of the South. According to the 1935 Census of Business, 40 percent of the working personnel was engaged in manufacturing, 17 percent in business and professional activities, and only 43 percent in farming. In fact, nearly three-fourths of the workers engaged in manufacturing in the state were in this unit.^{1/}

Industrialization of the unit is largely a result of the development of the textile industry. Textile mills in 1935 contributed four-fifths of the total value of articles manufactured, and directly employed one-third of the unit's working personnel. All localities, however, are not industrialized, for textile mills are concentrated in the upper Piedmont, especially in Greenville, Spartanburg, and Anderson counties.^{2/}

In addition to textile manufacturing, farming and forest industries are the basic sources of employment. Farms, growing chiefly cotton, are, like textile mills, somewhat concentrated in the upper Piedmont, whereas forest industries are more numerous in the middle and lower Piedmont.^{3/} For the region as a whole, forest products are valued at much less than either textiles or cotton.

Land Use

Most of the Piedmont unit, except for the mountainous strip in the extreme western portion, is rolling upland. In general the soils and climate are favorable for growth of both forests and agricultural crops. Topographical features and soil conditions, such as the rough terrain of the mountains and soil depletion and erosion in sections of the lower Piedmont, largely determine the type of land use.

^{1/}United States Department of Commerce, Personnel and Pay Roll in Industry and Business, and Farm Personnel, by Counties, 1937.

^{2/}South Carolina Department of Labor, First Annual Report, 1937, and United States Department of Commerce, Biennial Census of Manufactures: 1935, South Carolina.

^{3/}Three geographic divisions, in addition to the mountains in the northwestern edge of the unit, may be recognized -- the upper, middle, and lower Piedmont extending across the unit in a southwest-northeast direction.

Even though the Piedmont unit is now highly industrialized and heavily cultivated, 48 percent of the land is still in forests (table 1). Forests originally occupied practically all of the land, but by the time of the Civil War nearly half of the area had been cleared. Since that time agricultural land has been abandoned about as fast as new clearings have been made. Pine species usually became established on abandoned cropland through natural reforestation, with the result that most pine stands in the region are on land formerly cultivated.

Table 1. - Total land area classified by major use, 1936

Land use class ^{1/}	Area	Proportion of total area
	- - - Acres - - -	- - - Percent - - -
Forest:		
Productive	3,187,200	47.8
Nonproductive	<u>15,900</u>	<u>0.2</u>
Total forest	3,203,100	48.0
Nonforest:		
Agricultural		
Cropland	2,754,400	41.2
Pasture	204,400	3.1
Abandoned cropland	245,800	3.7
Towns, rights-of-way and miscellaneous uses	<u>264,900</u>	<u>4.0</u>
Total nonforest	3,469,500	52.0
Total land area	6,672,600	100.0

^{1/} See glossary, page 29 for explanation of terms.

There are indications, however, that the cultivated acreage is now tending to decrease and the forest acreage to increase. The Forest Survey in 1936 found nearly 250,000 acres of former cropland definitely abandoned (table 1), but only a relatively small amount of recently cleared land. Furthermore, the harvested acreage of cotton, the principal crop of the region, was less in South Carolina in 1938 than during any year since 1878.^{4/}

Activities of several governmental agencies designed to bring about diversification of agriculture in the region are fostering local programs

^{4/} Bureau of Agricultural Economics, Cotton Report as of December 1, 1938, Columbia, South Carolina.

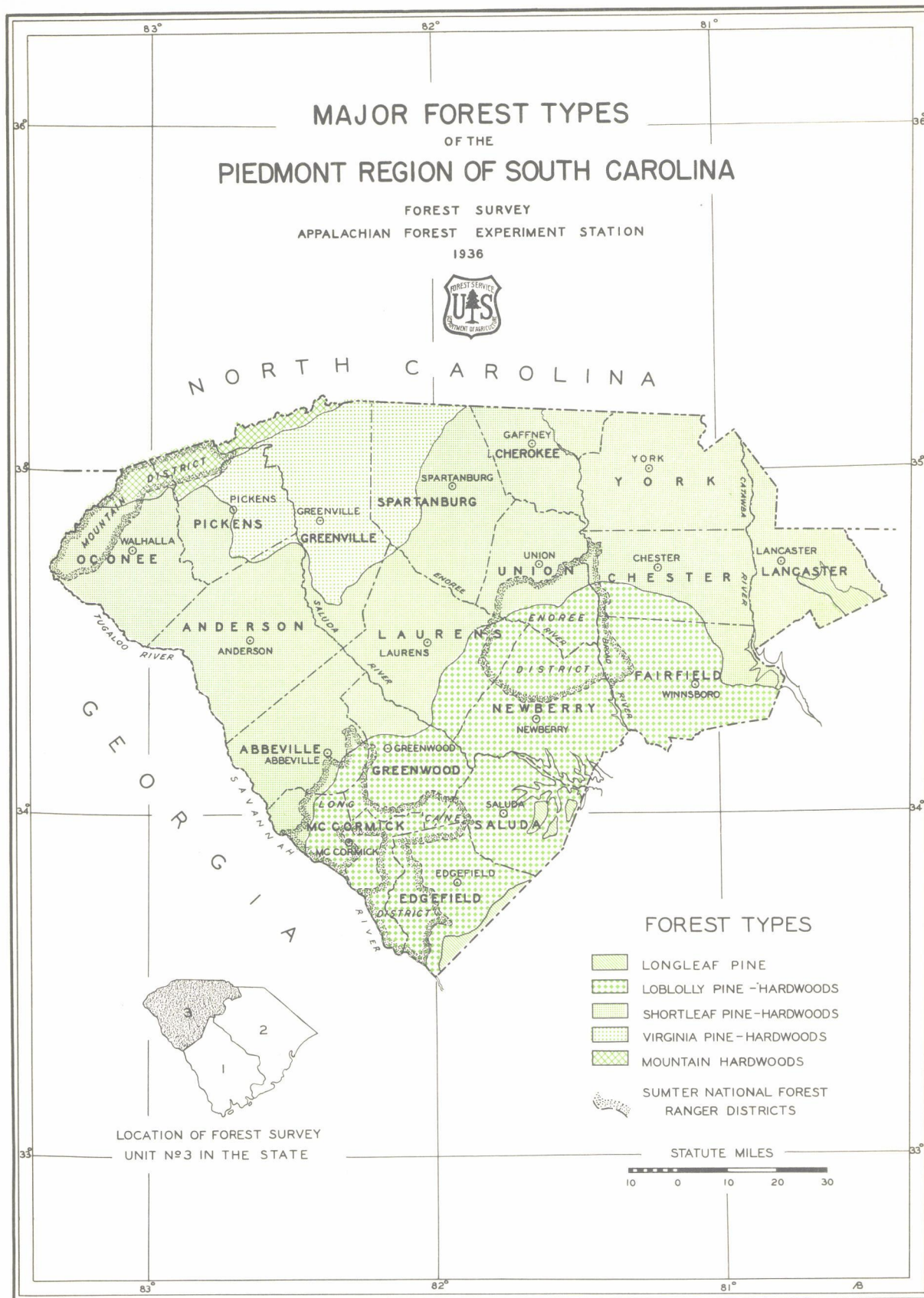


FIGURE 1.

of reforestation. The results are especially apparent through the increased area of woodland on farms whose owners are cooperating with the Soil Conservation Service. The Farm Security Administration is withdrawing submarginal areas from cultivation. Limitations by the Agricultural Adjustment Administration on the acreage of soil-depleting crops, especially cotton, as well as conservation payments for reforestation, are tending to increase the amount of forested land. The United States Forest Service, the South Carolina Forestry Commission, and the Agricultural Extension Service are also aiding individual landowners to recognize more clearly the returns to be expected from forest land with the result that many farmers are modifying their land use programs by planting trees or allowing unproductive agricultural land to reforest naturally. In addition, the submarginal farm land purchased by the United States within the boundaries of the three divisions of the Sumter National Forest (fig. 1) is being reforested.

The Erosion Problem

Past land use practices have resulted in a serious erosion problem throughout the Piedmont region of South Carolina. When cleared for cultivation, much of the land is particularly subject to erosion because of its rolling topography and friable soil, which alternately freezes and thaws during the winter months. Forty percent of the Forest Survey sample plots on cultivated land suffered from erosion, and on abandoned cropland, 68 percent of the plots were so affected.

Erosion was not restricted to the cropland of the unit. Of the forested sample plots 11 percent showed indications of sheet and shoestring erosion and another 6 percent were gullied. Such conditions were caused by removal of the forest cover without providing for adequate restocking to protect the soil from rapid run-off of surface water, and from abandonment of cultivated land on which subsequent natural reforestation had been too slow to overcome erosion. On the other hand, 9 percent of the forested plots gave evidence of recent erosion completely arrested by natural reforestation.

Erosion control on forest land in the unit, as well as on land removed from cultivation, requires the maintenance of an adequate vegetative cover to protect the soil. Since well-stocked forest stands usually afford the most practical means of providing this cover, the adoption of measures to promote reforestation will aid in solving the problem. In fact, one of the major returns to be expected from the forests of this region is in the conservation of its land and water resources.

Forest Ownership and Employment

Ownership of forest land is so distributed that forest and farming operations are closely interrelated. Two-thirds of the productive forest area is farm woodland, and provides at least part-time work for a major share of the 72,000 farmers living in the unit. Farm labor, furthermore, is extensively employed on the remaining one-third of the forest area.

On the Enoree, Long Cane, and Oconee divisions of the Sumter National Forest (fig. 1) special efforts have been made to provide forest work to supplement the income of economically depressed farmers. Although only one-fourth of the one million acres within the purchase boundaries of these divisions had been acquired by the United States by July 1, 1938, it has been demonstrated that through a planned program the forest resources of specific localities can provide a substantial part of the farm income -- a much more substantial part than is customarily received from farm woodland over the region as a whole.

Since less than 20 percent of forest land in the unit belongs to commercial and industrial firms, the forest resource will no doubt continue to be an asset primarily to farmers. The forest resource can furthermore become of steadily increasing value through development and proper use and eventually occupy an even more important place in the economy of both farm and industrial owners.

THE FOREST RESOURCE

Forest Area

Of the total forest land, 3,187,200 acres are productive and 15,900 acres are non-productive (table 1). The non-productive area appeared incapable of supporting merchantable trees, and is omitted from the description of the forest area. The productive forest area is classified by type, based on the predominating tree species, and by condition, based on board foot volume per acre, age of dominant trees, and cutting history.

Forest Types

Five broad forest type-groups have been recognized in the unit, shortleaf pine, loblolly pine, Virginia pine, upland hardwoods, and bottomland hardwoods (table 2). The chief commercial species, shortleaf and loblolly pines, predominate, respectively, on 56 percent and 22 percent of the forest area. The combined pine type-groups occupy approximately four-fifths of the productive forest land. In general, pine types are located on land formerly cultivated, and many of the trees have the limby appearance of "old-field" stands.

Although hardwood types are found on only 19 percent of the forest area, hardwood species form an important component of most pine types and make up 41 percent of the cubic foot volume of wood in the unit (table 7). Oaks, yellow poplar, and hickories predominate in the upland hardwood type group, occurring in small tracts throughout the Piedmont and in a rather solid block on the slopes of the mountains. The bottomland hardwood type-group, conversely, is confined to the level areas adjoining the major streams and is composed chiefly of red gum, yellow poplar, and oaks.

The various type-groups tend to dominate broad areas, as indicated on the map (fig. 1). Shortleaf and Virginia pine types predominate in the middle and upper Piedmont, whereas loblolly pine, with small tracts of longleaf pine, prevails in the lower Piedmont. Hardwood types occur throughout the unit, but are dominant only in the mountain section. Within these broad areas many different but less prevalent forest types occur, as well as extensive areas of cultivated land. The area dominated by the major type groups as shown on the map is therefore not comparable with the acreage figures given in table 2.

Forest Condition

The present condition of the timber stands with relation to age, volume per acre, and past cutting practice is indicated in table 2. Slightly over half of the forest area contains sufficient saw-timber

Table 2. - Productive forest area classified by forest condition and type group

Forest condition	Type group					Total	Proportion of total
	Shortleaf pine	Loblolly pine	Virginia pine	Upland hardwoods	Bottom-land hardwoods		
	----- Acres -----						Percent
Sawlog size:							
Old growth:							
Uncut	46,100	8,700	1,600	47,700	28,700	132,800	4.2
Partly cut	94,700	6,400	4,000	52,500	11,900	169,500	5.3
Total	140,800	15,100	5,600	100,200	40,600	302,300	9.5
Second growth:							
Uncut	423,900	177,400	27,000	58,900	50,100	737,300	23.1
Partly cut	367,500	145,500	16,700	55,700	16,700	602,100	18.9
Total	791,400	322,900	43,700	114,600	66,800	1,339,400	42.0
Total sawlog size	932,200	338,000	49,300	214,800	107,400	1,641,700	51.5
Under sawlog size:							
Second growth	770,700	324,500	52,500	160,700	89,900	1,398,300	43.9
Reproduction and clearcut ^{1/}	76,400	43,000	9,600	9,500	8,700	147,200	4.6
Total under sawlog size	847,100	367,500	62,100	170,200	98,600	1,545,500	48.5
Total all conditions	1,779,300	705,500	111,400	385,000	206,000	3,187,200	100.0
Percent of total	55.8	22.1	3.5	12.1	6.5	100.0	

^{1/} Includes 4,800 acres classified as clearcut.

material to meet the requirements of the sawlog-size condition classes. Old-growth stands remain on less than 10 percent of the forest area, and over half of these areas have been culled for select species and high quality material. With the exception of a few large blocks in the mountains, the old-growth stands are in scattered small tracts.

The 42 percent of the forest area supporting second-growth sawlog-size stands is the condition class of greatest immediate interest as a source of raw material. Pine stands predominate, occupying 86 percent of the area.

Second-growth under-sawlog-size stands occupy 44 percent of the forest area, an unusually large proportion in comparison with the 28 and 33 percent, respectively, of the Northern and Southern Coastal Plain units in this condition class. Such stands contain an extremely important share of the future growing stock of the Piedmont region. But, since the trees are young, the area must be adequately protected from fire and efficiently managed to weed out inferior species and cull trees if it is to provide the supply of quality raw materials of which it is capable. The type of management given to these young stands during the next two decades will determine whether nearly half of the forest area will contribute its full share of raw materials to the economic progress of the region, or whether it will continue to be merely a partially developed resource.

Less than 5 percent of the forest area is classified under the reproduction and clearcut conditions. Areas classified as reproduction have sufficient seedlings or sprouts of commercial species eventually to develop into commercial stands. The clearcut area alone, estimated at only 4,800 acres, is small, indicating that natural reforestation is taking place on most cutover land.

The large percentage of the forest land in the under-sawlog-size conditions is attributed not only to extensive young stands developing on recently abandoned fields, but also to the general practice of cutting small diameter trees for lumber and other uses. This is particularly true in the more heavily cultivated sections of the unit. In general, pine species are even more heavily cut than hardwoods, and this may reduce the relative proportion of softwood material in future stands.

As a result of the wide-spread practice of cutting small trees, together with the failure of many areas to restock adequately through natural reforestation, stand density is generally low. The degree of understocking in the two major pine type groups is indicated by comparing the average cordwood volume per acre on uncut areas in representative age-classes with the respective average volumes weighted by site on the most

heavily stocked 10 percent of the area in these type and age classes:

Average volume per acre for loblolly and shortleaf pine type groups,
uncut conditions

Age-class	Entire area	Best 10 percent of area	Relation entire area to best 10 percent
<u>Years</u>	<u>Cords</u>	<u>Cords</u>	<u>Percent</u>
21 - 30	6.2	18.0	34
41 - 50	13.8	27.6	50
61 - 70	16.0	30.8	52

Although the best stocked 10 percent of these pine type groups does not represent the optimum stocking obtainable under intensive management, it does represent a degree of stocking obtainable for most of the forest area under reasonable protection and cutting practices.

Understocking in this unit is economically significant chiefly because of its effect on the quality and quantity of timber grown and the effectiveness of watershed protection provided. Thin stands, especially those of "old-field" origin, do not as a rule provide material of high quality and volume, nor adequately protect the soil from erosion.

Forest sites over the region as a whole are generally favorable for timber production even though many forest stands are on land that had been abandoned for agriculture. Timber production is dependent upon many factors, such as climate, soil, and topography, and the effect of these combined factors on the forest growth of a given area is measured by site indices. Pine site indices were 60 or better for two-thirds of the unit's pine-type area; i.e., dominant pine trees on these areas can be expected to reach a height of at least 60 feet in 50 years. Hardwood site indices, based on the form, height, and general appearance of the stands, were fair to good for four-fifths of the hardwood-type area; i.e., mature hardwood trees on these areas can be expected to have a merchantable length of 2 logs or more. Only one-fifth of the area in hardwood types, and one-third of the area in pine types, had poor site indices.

Timber Volumes

Volume estimates include the sound volume of all living trees 5.0 inches d.b.h. and over as of 1936. The sawlog portion of all trees suitable for sawtimber (softwoods 9.0 inches d.b.h. and larger and hardwoods 13.0 inches d.b.h. and larger) is expressed in board feet, and the entire volume of all trees is expressed in cords including bark, and in cubic feet excluding bark.

Sawtimber Volumes

The volume of sawtimber is shown by species in table 3, computed separately by the International $\frac{1}{4}$ -inch, Scribner, and Doyle log rules. All volumes are net, that is deductions have been made for all volume losses caused by crook, limbiness, rot, butt wounds, and other defects. Although the Doyle and Scribner scales are more commonly used in the unit by the lumber industry, the International $\frac{1}{4}$ -inch scale gives a more accurate measure of actual lumber production, and is used in subsequent board-foot tables in this report.

The net volume of sawtimber in the unit computed by International rule is nearly 6 billion board feet, 67 percent larger than by Doyle rule and 16 percent larger than by Scribner rule.

Table 3. - Net volume classified by major species group in International $\frac{1}{4}$ -inch, Scribner, and Doyle log rules $\frac{1}{4}$

Major species group	International $\frac{1}{4}$ -inch ^{2/}	Scribner	Doyle
----- Thousand ft. b.m. -----			
Softwoods:			
Loblolly pine ^{3/}	1,327,000	1,124,600	750,600
Shortleaf pine	2,644,500	2,202,700	1,398,000
Virginia pine	168,800	140,200	84,500
White pine and hemlock	96,500	88,200	76,600
Total softwoods	4,236,800	3,555,700	2,309,700
Hardwoods:			
Red gum	309,600	279,900	220,000
Yellow poplar	448,400	410,800	341,900
Red oak	301,500	274,500	225,100
White oak	289,000	263,300	216,200
Hickory	140,100	128,900	99,300
Others	238,900	213,800	167,100
Total hardwoods	1,727,500	1,571,200	1,269,600
Total all species	5,964,300	5,126,900	3,579,300

^{1/}Excludes chestnut.

^{2/}The scale by International $\frac{1}{4}$ -inch rule approximates green lumber tally.

^{3/}Includes small quantity of longleaf pine.

Table 4. - Net board foot volume classified by forest condition and species group (International $\frac{1}{4}$ -inch rule)

Species group	Forest condition					Total	Proportion of total
	Sawlog size				Under sawlog size ^{1/}		
	Old growth		Second growth				
	Uncut	Partly cut	Uncut	Partly cut			
- - - - - Thousand ft. b.m. - - - - - Percent							
Softwoods:							
Loblolly pine	74,900	50,600	768,100	348,100	85,300	1,327,000	22.2
Shortleaf pine	280,800	345,000	1,141,200	710,200	167,300	2,644,500	44.4
Virginia pine	9,400	9,500	95,400	42,200	12,300	168,800	2.8
White pine and hemlock	71,000	14,200	9,500	1,600	200	96,500	1.6
Total soft-woods	436,100	419,300	2,014,200	1,102,100	265,100	4,236,800	71.0
Hardwoods:							
Red gum	58,800	32,500	112,800	89,600	15,900	309,600	5.2
Yellow poplar	127,500	68,500	137,800	101,700	12,900	448,400	7.5
Red oak	65,900	67,800	84,800	67,600	15,400	301,500	5.0
White oak	73,400	82,100	71,200	46,400	15,900	289,000	4.9
Hickory	39,100	38,300	29,200	26,000	7,500	140,100	2.4
Others	45,700	24,000	107,500	45,800	15,900	238,900	4.0
Total hard-woods	410,400	313,200	543,300	377,100	83,500	1,727,500	29.0
Total all species	846,500	732,500	2,557,500	1,479,200	348,600	5,964,300	100.0
Percent of total	14.2	12.3	42.9	24.8	5.8	100.0	

^{1/}Includes 4.1 million board feet on the areas classified as reproduction and clearcut.

In table 4 a classification is made of board foot volume by species group and forest condition. Nearly half (44 percent) of the total volume is shortleaf pine, and almost one-fourth (22 percent) loblolly pine. All hardwoods combined make up 29 percent, red and white oaks, yellow poplar, and red gum being the principal species.

Old-growth stands contain 26 percent of the total board foot volume -- 20 percent of the pine volume, and 42 percent of the hardwood volume. This does not mean, however, that all of the volume in the old growth condition class is high quality material. Half is in partly cut

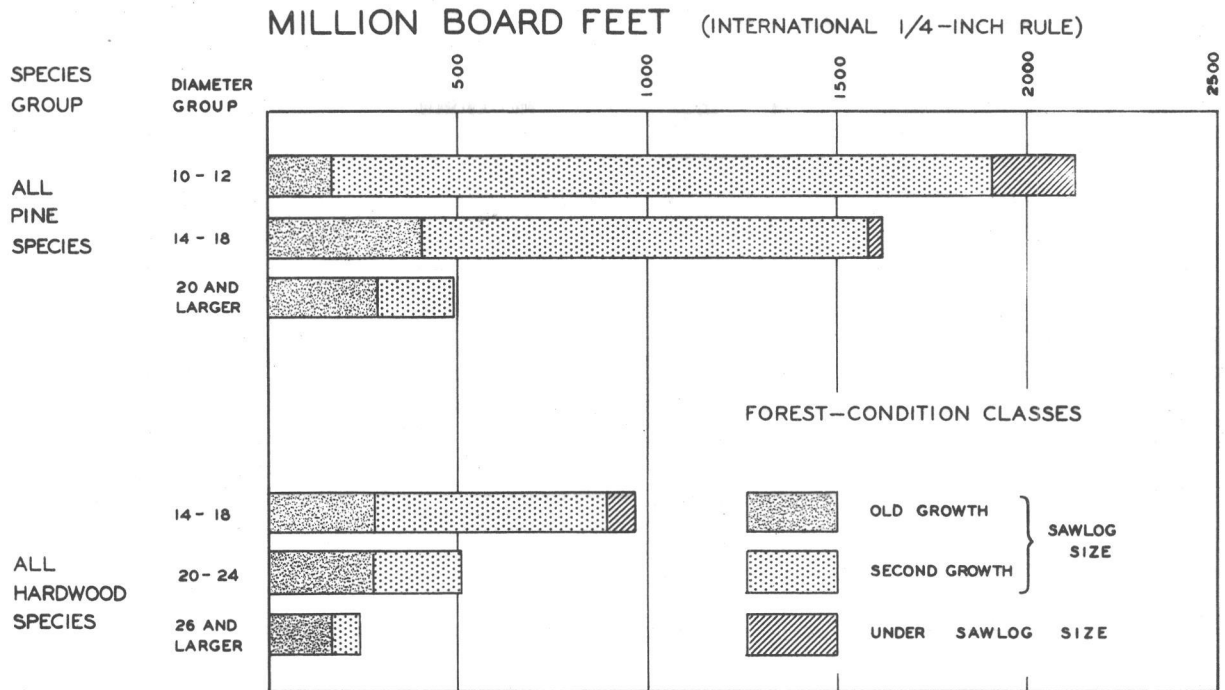


FIGURE 2.- DISTRIBUTION OF NET BOARD-FOOT VOLUME BY DIAMETER GROUP AND FOREST CONDITIONS

stands, previously culled over for the more valuable species and high grade trees, and a portion of the remainder is in either over-mature stands or stands on sites so poor that much of the timber is of low quality. Moreover, a considerable portion of the volume in old-growth stands is in trees of small diameter.

A classification of board-foot volume according to diameter groups and forest conditions is made in figure 2. This chart emphasizes the preponderance of small diameter trees, especially of pines, in all of the condition classes. Half of the total sawlog volume of softwoods is in trees of the 10- and 12-inch diameter classes, and nine-tenths in trees under 19.0 inches d.b.h. More than half of the hardwood volume is in trees under 19.0 inches.

Most of the sawtimber in the region is accessible. The general use of portable sawmills and the well developed transportation system of highways and railroads permits ready access to nearly all areas. Figure 3 showing the proportional distribution of area and board-foot volume for the sawlog stands indicates that stand density is usually sufficient for economic operation. Although one-third of the area in sawlog stands contains less than 2,000 board feet per acre, 86 percent of the volume of both hardwood and pine type groups is in stands of 2,000 board feet or more. More-

over, 32 percent of the volume in pine types, and 38 percent in hardwood types, is in stands of 6,000 board feet or more per acre, concentrated on 12 percent and 15 percent, respectively, of the area in these types.

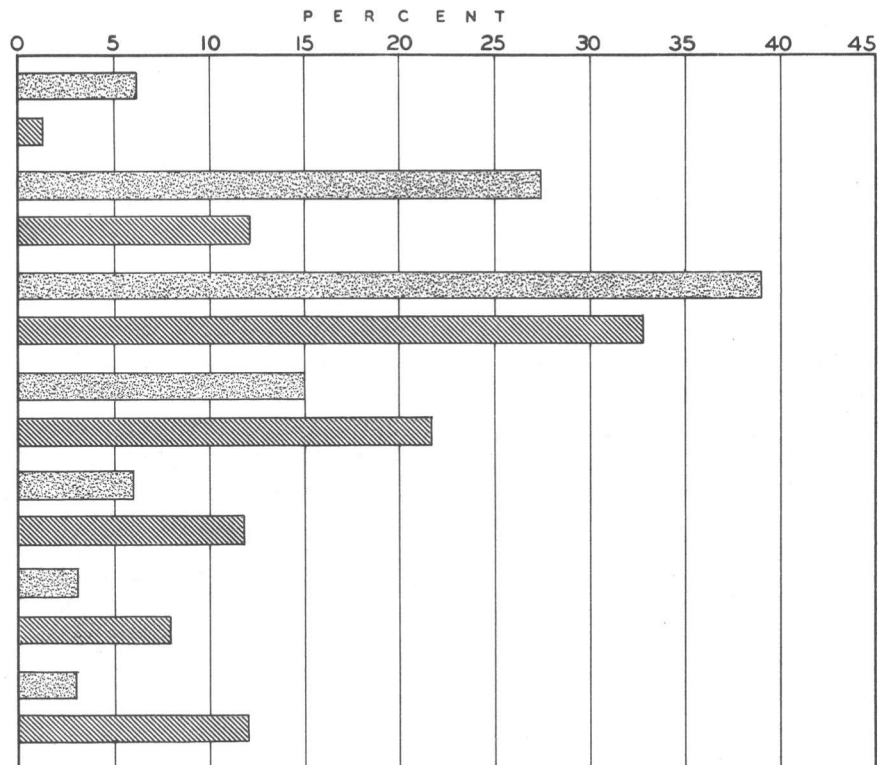
In order to break down the sawtimber volumes into figures more easily comparable with those for similar forest conditions and species groups in other forested areas, table 5 has been prepared to show the average sawtimber volume per acre classified by type group, species group, and forest condition. The average volumes for sawlog-size condition classes range from 7,200 board feet for the uncut old-growth softwood types to 2,230 for the partly-cut, second-growth hardwood stands, with an average of 3,420 board feet for all sawlog stands. For the entire forest area, including both sawlog-size and under-sawlog-size stands, the average is 1,870 board feet per acre. These averages are lower than those in the Coastal Plain section of the state. The Northern Coastal Plain unit, for instance, has an average of 5,180 board feet per acre for sawlog stands, and 3,300 board feet for the entire forest area.

Table 5. - Average net sawtimber volume per acre classified by type group, species group, and forest condition

Type group and species group	Forest condition						Average all conditions
	Sawlog size					All under sawlog-size conditions	
	Old growth		Second growth		Average all sawlog size conditions		
	Uncut	Partly cut	Uncut	Partly cut			
----- <u>Board feet per acre</u> -----							
Softwood type group:							
Species:							
Softwoods	6,100	3,690	3,140	2,050	2,870	200	1,550
Hardwoods	1,110	1,110	430	440	520	30	280
Total	7,210	4,800	3,570	2,490	3,390	230	1,830
Hardwood type group:							
Species:							
Softwoods	1,200	490	390	260	570	70	350
Hardwoods	4,560	3,050	2,510	1,970	2,980	150	1,690
Total	5,760	3,540	2,900	2,230	3,550	220	2,040
All types:							
Species:							
Softwoods	3,280	2,470	2,730	1,830	2,420	170	1,330
Hardwoods	3,090	1,850	740	630	1,000	60	540
Total	6,370	4,320	3,470	2,460	3,420	230	1,870

PINE TYPE-GROUP

NET VOL.-PER-ACRE CLASS
(BOARD FEET - INT. 1/4-IN. RULE)



HARDWOOD TYPE-GROUP

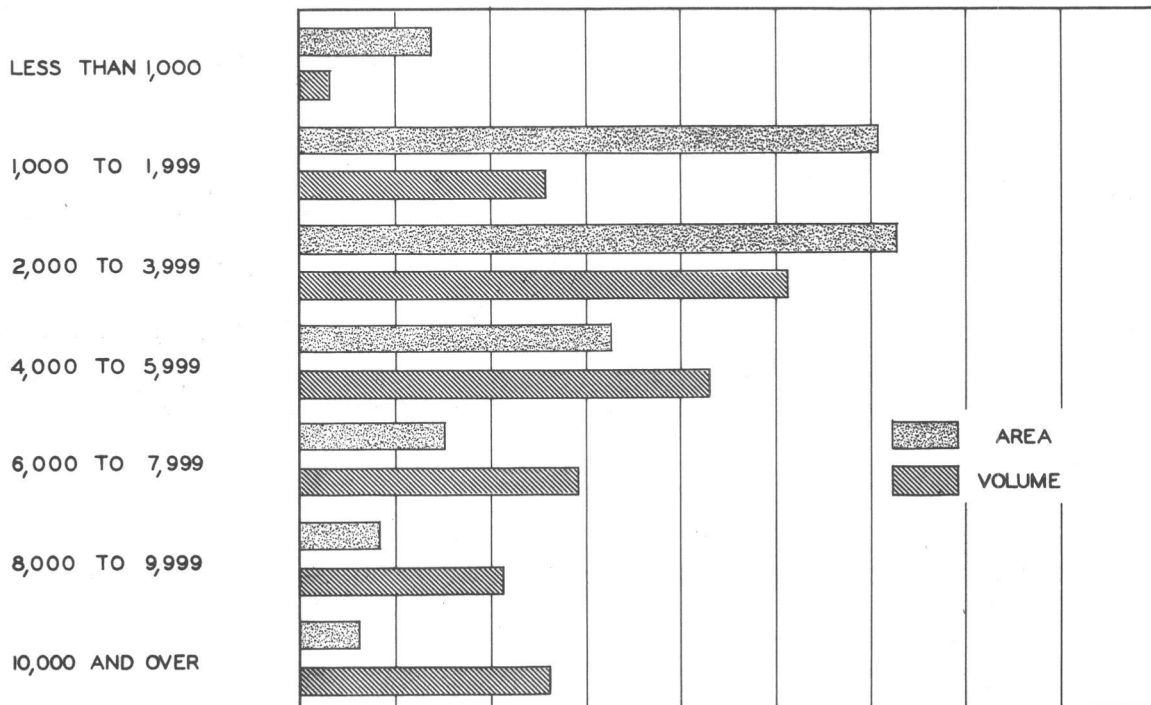


FIGURE 3.- PROPORTIONAL DISTRIBUTION OF AREA AND BOARD-FOOT VOLUME IN THE SAWLOG-SIZE CONDITIONS BY VOLUME-PER-ACRE CLASSES

Cordwood Volume

The total volume of wood in all living trees 5.0 inches d.b.h. and over amounted to nearly 37 million cords (table 6). Sawlog trees including tops are the source of 53 percent of the total volume, sound under-sawlog-size trees 35 percent, and cull trees 12 percent. The fact that softwood species make up only 56 percent of the cordwood volume, as against 71 percent of the sawtimber volume, is largely attributable to the lower diameter limit of softwood sawlog material.

Table 6. - Net cordwood volume classified by species group and source of material^{1/}

Species group	Source of material				Total	Proportion of total
	Sawlog material	Tops of sawlog size trees ^{2/}	Under sawlog size trees	Cull trees		
	----- Cords ^{3/} -----					Percent
Softwoods:						
Loblolly pine ^{4/}	3,190,900	729,000	1,929,900	256,700	6,106,500	16.8
Shortleaf pine	6,762,200	1,118,600	4,735,800	530,500	13,147,100	36.0
Others	565,300	139,600	341,900	111,500	1,158,300	3.1
Total softwoods	10,518,400	1,987,200	7,007,600	898,700	20,411,900	55.9
Hardwoods:						
Red gum	767,400	418,300	992,600	276,000	2,454,300	6.7
Yellow poplar	1,069,900	615,600	662,700	232,000	2,580,200	7.0
Red oaks	780,600	405,300	926,500	552,200	2,664,600	7.3
White oaks	761,400	389,000	1,028,400	600,200	2,779,000	7.6
Others	993,900	514,800	2,243,300	1,881,800	5,633,800	15.5
Total hardwoods	4,373,200	2,343,000	5,853,500	3,542,200	16,111,900	44.1
Total all species	14,891,600	4,330,200	12,861,100	4,440,900	36,523,800	100.0
Percent of total volume	40.7	11.9	35.2	12.2	100.0	

^{1/} 86,800 cords of standing chestnut suitable for extract wood omitted.

^{2/} Includes the usable portion of the upper stems of softwoods and of the upper stems and limbs of hardwoods to a minimum diameter limit of 4 inches outside bark.

^{3/} Standard cord (4' x 4' x 8') including bark.

^{4/} Includes a small quantity of longleaf pine.

Effective utilization of the cordwood volume in hardwood cull trees is a major forest problem in the unit. Nearly one-fourth of the entire hardwood volume is cull material, amounting to four-fifths of the cordwood volume in all cull trees. Present cutting practices unfortunately tend to increase the percentage of cull trees, for as a rule only sound trees are cut.

Cubic-foot Volume

Table 7 shows the volume of solid wood inside bark in terms of cubic feet. This unit of measurement is well adapted to all products and to all parts of the tree, and provides the best basis for calculating net changes in total forest capital as a result of growth, mortality, and drain.

Table 7. - Net cubic foot volume (inside bark) of all material classified by species group and source, 1936

Species group	Source of material				Total	Proportion of total
	Sawlog size trees		Under saw-log size trees	Cull trees		
	Sawlog material	Tops ^{1/}				
<hr/>						
	----- <u>Thousand cu. ft.</u> -----					<u>Percent</u>
Softwoods	736,590	167,720	470,590	63,310	1,438,210	58.6
Hardwoods	292,340	137,300	368,990	216,760	1,015,390	41.4
	<hr/>					
Total	1,028,930	305,020	839,580	280,070	2,453,600	100.0
	<hr/>					
Percent of total	42.0	12.4	34.2	11.4	100.0	

^{1/}Includes the usable portion of the upper stems of pines and of the upper stems and limbs of hardwoods, to a minimum diameter limit of 4 inches outside bark.

Poles and Piles

Trees suitable for poles and piles bring a higher price when sold for this purpose than when utilized as sawlogs. For this reason an estimate has been made of the number of pine trees meeting the requirements for such use. Because many of these trees will be cut for lumber or other products, the information is valuable chiefly in showing the ratio between the number of sticks in the different diameter and length groups.

Only one-fifth of the 7.6 million pine trees (table 8) classified as suitable for poles and piles would make sticks 30 feet or longer, more than half being limited to 20-foot sticks.

Table 8. - Total number of pine poles and piles classified by length and diameter

Diameter class ^{1/}	Length of stick in feet					Total	Proportion of total
	20	25	30	35	40+		
<u>Inches</u>	<u>Thousand sticks</u>						<u>Percent</u>
7.0 - 8.9	2,457	741	168	--	--	3,366	44.4
9.0 - 10.9	1,164	675	350	93	47	2,329	30.8
11.0 - 12.9	392	419	351	149	41	1,352	17.9
13.0 - 14.9	63	121	170	106	24	484	6.4
15.0 - 16.9	--	6	16	11	2	35	0.5
Total	4,076	1,962	1,055	359	114	7,566	100.0
Percent of total	53.9	26.0	13.9	4.7	1.5	100.0	

^{1/}Diameter $4\frac{1}{2}$ feet above ground, outside bark.

Forest Growth

Forest income from a long range point of view depends upon forest growth and increment as well as upon the timber volume standing at any one time. The term "forest growth" is used in this report to include the volume of wood accruing annually to merchantable trees, together with the volume of sound trees coming into the specified minimum diameter classes during the year.

The increment, or net volume of wood produced during any given year, is the volume of forest growth for that year less the volume loss through mortality from forest fires and from various natural causes such as tree competition, insect damage, disease, and windthrow. Increment thus represents the volume of sound wood available for cutting without depleting the forest capital.

In 1936 the total forest growth of the Piedmont unit was 151 million cubic feet (table 12). Mortality during that year amounted to 22 million cubic feet, a volume equal to 14 percent of total growth. The net increment for 1936 was therefore 129 million cubic feet, including 404 million board feet of sawtimber (table 13).

The average net increment per acre varies considerably among the different condition classes. During 1937, the latest year for which data on growth have been computed, the net increment varied from an average of 1.8 cubic feet (.03 cord) on the reproduction and clearcut condition to 58.1 cubic feet (.84 cord) on the second-growth sawlog-size condition (table 9). For the entire forest area, an average net increment per acre of 41.6 cubic feet (.61 cord), including 129 board feet of sawlog material, was realized. This may be compared with a per acre average of 31.6 cubic

Table 9. - Average net increment per acre classified by forest condition and type of material - 1937

Forest condition	Sawlog-size material			All sound material	
	Softwoods	Hardwoods	Total	Including bark	Excluding bark
	- - - - Board feet - - - -			Cords	Cu. ft.
Sawlog-size:					
Old growth:					
Uncut	55	60	115	.26	18.3
Partly cut	66	48	114	.39	26.9
Second growth:					
Uncut	197	44	241	.84	58.1
Partly cut	109	33	142	.60	40.8
Under sawlog-size:					
Second growth	67	13	80	.62	41.3
Reproduction and clear cut	8	2	10	.03	1.8
Weighted average all conditions	102	27	129	.61	41.6

feet, including 149 board feet, in the adjoining Northern Coastal Plain unit of the state.

The average increment per acre is simply an average by each condition without distinction between species and types and without considering the effect of cutting during the year. Such yields cannot be applied to any given locality, since the species distribution by condition is not likely to be similar to the average distribution for the region. Furthermore, net increment on specific areas not only depends upon the proportion of faster growing species, but also on site, stocking, age, and management. The figures do indicate, however, the average to be expected per acre from each condition for the region as a whole so long as no significant change occurs in species distribution or in other factors affecting growth and mortality.

FOREST RESOURCE UTILIZATION

The direct income from the forests of the region was chiefly from fuelwood and lumbering operations. Lumber was the principal commercial product, although a much greater volume of wood was cut for fuel. Indirect returns, particularly through soil and water conservation, were highly important, but for this study no attempt was made to determine their value.

Forest Industries

Lumber Industry

A total of 362 mills, mainly of the small portable type, were operated in the region during 1936 (table 10). Only two had a 10-hour day capacity of more than 10,000 board feet, and none more than 20,000 board feet (fig. 4). These mills cut 154 million board feet, an average of 425,000 board feet per mill for the entire year. Such a small average cut is a result not only of the limited capacity of the mills, but also of the fact that many were operated on a part-time basis. Even though small portable sawmills usually waste material, both in the woods and at the mill, and frequently produce poorly manufactured lumber, this type of mill will probably continue to dominate the local lumber industry because of the prevalence of farm woodland with young timber stands.

Fuelwood Industry

In terms of quantity of wood consumed, the greatest contribution of the forests of the unit during 1936 was fuelwood. A total of 1,237,000 cords was cut (table 10), about half from sound trees and the remainder from dead and cull trees and tops of trees cut for other purposes.

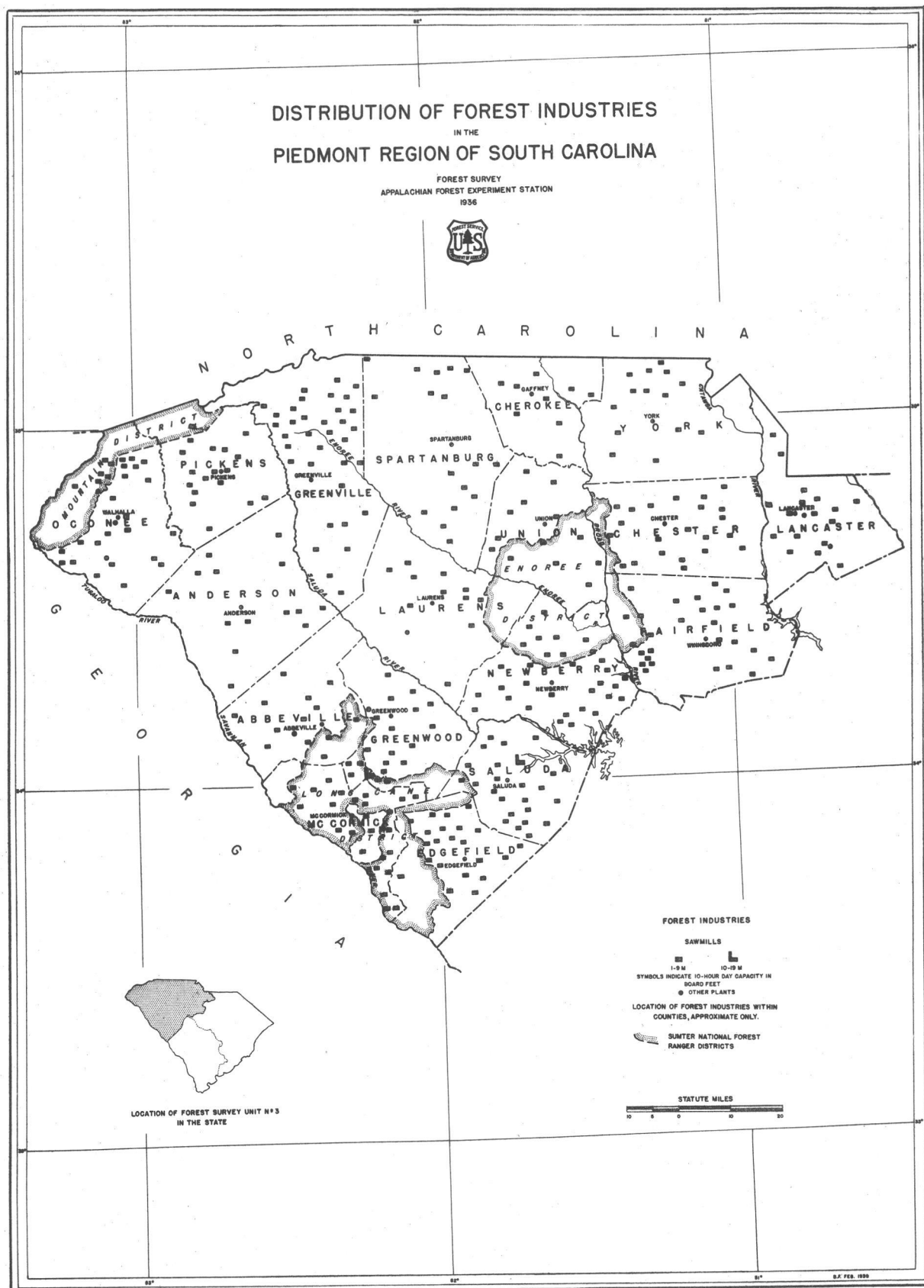
Fuelwood is more important as a subsistence crop than as a cash crop, for farmers produce and consume the major portion. Consumption in this unit, however, is considerably increased by the fuelwood requirements of the unusually large rural non-farm population of the small textile mill communities.

The active fuelwood demand provides an opportunity for utilizing the large amount of cull hardwood material. A larger part of the fuelwood should be cut from cull trees, thereby aiding in the development of more productive stands.

Miscellaneous Industries

During 1936 several minor industries were supported by the forest resources of the region. Many poles, piles, and crossties were cut, several shingle and dimension stock mills were operated, and a small amount of pulpwood was shipped. The total volume of wood used for such purposes, however, was small in comparison with the lumber and fuelwood production.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1936



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Table 10. - Production and employment in the primary wood-using industries, 1936

Commodity	Number of plants	Quantity produced	Employment		
			In woods	In mill	Total
<u>M ft. b.m.</u> - - - <u>Thousand man-days</u> - - -					
Lumber	362	154,000	179	240	419
		<u>Pieces</u>			
Poles and piles	-	45 M	10	-	10
Crossties	-	112 M	16	-	16
		<u>Cords</u>			
Other commercial uses	8 ^{1/}	25 M	27	1	28
Fuelwood	-	1,237 M	1,485	-	1,485
Domestic farm use ^{2/}	-	47 M	51	-	51
Total			1,768	241	2,009

^{1/}Includes five shingle mills and three dimension stock mills.

^{2/}Includes fence posts and other items exclusive of fuelwood.

Employment

In 1936 slightly more than 2 million man-days of labor were provided by the forest industries (table 10). This is equivalent to full-time employment, based on 250 days per year, for 8,000 people. Actually, however, forest industries were of direct benefit to many more than 8,000 workers, for forest operations usually constitute only part-time employment.

Forest industries, as previously pointed out, are closely interrelated with farming activities. Probably half of the sawmills are operated by farmers on a part-time basis. Fuelwood production, which accounted for three-fourths of the total forest employment, is largely a part-time farm activity. Most of the farmers, representing 43 percent of the total workers of the unit, receive a portion of their income either through employment in primary wood-using industries or by cutting fuelwood for their own use.

Commodity Drain

Part of the wood cut in this unit during 1936 was obtained from sound trees, and part from dead and cull material. Since only sound trees constitute the growing stock, it is necessary to know the volume coming from them to determine the drain on the productive forest resource through utilization. Such drain or cut is termed "commodity drain".

Table 11. - Commodity drain from sound trees - 1936

Commodity	Sawlog-size material			All material			
	Soft-woods	Hard-woods	Total	Soft-woods	Hard-woods	Total	Percent of total
	- <u>Thousand ft. b.m.</u> ^{1/}			- - <u>Thousand cu. ft. (i.b.)</u> - - -			
Lumber	147,300	5,500	152,800	31,510	940	32,450	38.6
Poles and piles	4,300	--	4,300	920	--	920	1.1
Crossties	1,200	5,900	7,100	260	1,020	1,280	1.5
Other commercial use	3,400	600	4,000	1,470	290	1,760	2.1
Fuelwood	63,900	37,300	101,200	26,430	18,110	44,540	52.9
Domestic farm use	4,600	1,400	6,000	2,510	700	3,210	3.8
Total	224,700	50,700	275,400	63,100	21,060	84,160	100.0

^{1/}Lumber tally.

Material cut from sawlog-size trees for all uses, including usable material left in the woods as waste, amounted in 1936 to 275 million board feet. The total commodity drain, from both sawlog-size and sound under-sawlog-size trees, was 84 million cubic feet (table 11). Approximately 39 percent of the cubic foot volume was used for lumber, 5 percent for other commercial products, and 56 percent for fuelwood and farm uses. Pine species supplied 97 percent of the lumber drain and 75 percent of the total commodity drain.

Increment Compared with Commodity Drain

In order to show whether the timber volume is being depleted or increased, forest increment is compared with commodity drain. Although 1936, the year for which the comparison is made, was in many respects a normal or average year, similar studies must be made at regular intervals to determine accurately any definite trend.

Table 12. - Comparison between increment and commodity drain -
all material

	Softwoods	Hardwoods	Total
- - - Thousand cu. ft. (i.b.) - - -			
Growing stock, January 1, 1936	1,344,130	646,930	1,991,060
Growth	109,230	41,700	150,930
Mortality	-15,360	-6,240	-21,600
Forest increment	93,870	35,460	129,330
Commodity drain	-63,100	-21,060	-84,160
Net change in growing stock, 1936	+30,770	+14,400	+45,170
Growing stock, January 1, 1937	1,374,900	661,330	2,036,230

During 1936 a volume equivalent to 67 percent of the cubic foot increment in sound softwood trees, and 59 percent in sound hardwoods, was cut. Consequently, the growing stock of the unit was increased by 30,770,000 cubic feet of softwood and 14,400,000 cubic feet of hardwood (table 12). The board foot volume of sawlog material also similarly increased (table 13).

Table 13. - Comparison between increment and commodity drain -
sawtimber material

	Softwoods	Hardwoods	Total
- - - Thousand ft. b.m. - - -			
Growing stock, January 1, 1936	4,143,000	1,692,400	5,835,400
Growth	355,100	100,000	455,100
Mortality	-36,600	-14,200	-50,800
Forest increment	318,500	85,800	404,300
Commodity drain	-224,700	-50,700	-275,400
Net increase in growing stock, 1936	+93,800	+35,100	+128,900
Growing stock, January 1, 1937	4,236,800	1,727,500	5,964,300

In view of the unit's deficiency in growing stock, the 1936 surplus of increment over commodity drain was distinctly favorable. Continued surpluses will gradually build up the growing stock in both volume and quality. The 1936 surplus, amounting to 35 percent of the increment, is in fact large enough to provide for some expansion in wood-using industries if market conditions warrant. Moderate expansion would partly meet the pressing immediate need for increased financial income in the unit and still provide for stand improvement. Any considerable reduction of the surplus in future years, however, will increase the time otherwise required to achieve reasonably adequate stocking over the forest area as a whole.

GENERAL FOREST SITUATION

Summary

Although the general economy of the Piedmont region is based largely on the textile industry and cotton production, forests and forest industries occupy an important place. Nearly half of the land area is still in forests, and forest industries provide part of the livelihood for a large portion of the rural population, especially farmers, who own two-thirds of the forest land.

The ratio between forest and cleared land has remained relatively stable since the Civil War. Much of the land, however, has passed through cycles of clearing and abandonment with the result that a large proportion of the present forest area is on land formerly cultivated. In recent years there has been a tendency toward an increase in forest land and a decrease in cultivated land -- an effect of both the general economic depression of agriculture and the conservation activities of public agencies.

Pine type groups predominate on four-fifths of the forest land. Pine stands are closely intermingled with cultivated areas, and, as a result of past land-use practices, often possess the limbiness characteristic of old-field forest growth. Hardwood types, predominant on only one-fifth of the forest area, are confined to the mountain slopes and small scattered areas throughout the Piedmont, but hardwood species are important associates in most pine stands. Forty-one percent of the cubic-foot volume in the unit is hardwood.

Timber stands in general are young. Nearly half of the forest area is in the under-sawlog-size condition classes, and less than one-tenth is in old growth. Half of the total pine sawtimber volume is in trees in the 10- and 12-inch diameter groups, and four-fifths of the volume of all species is in trees less than 19.0 inches in diameter.

Both the quality and quantity of timber on much of the area suffer from understocking. The average stocking on uncut shortleaf and loblolly stands, for instance, is less than half that on the best ten percent of these stands. Site indices, however, indicate favorable growing conditions over the area as a whole, with potentialities at present only partially realized.

Approximately 6 billion board feet of sawtimber was standing in 1936, nearly half of which was shortleaf pine and another quarter other pine species. Stands for sawlog-size conditions averaged 3,420 board feet per acre, and for the entire forest area, 1,870 board feet.

The total volume of all living trees 5.0 inches d.b.h. and larger was 37 million cords -- 56 percent softwoods and 44 percent hardwoods. Cull trees comprised 22 percent of the hardwood volume and 4 percent of the pine volume.

Increment for the unit as a whole is high in view of the understocked condition of the stands. The average per acre increment is .61 cords, including 129 board feet of sawlog-size material. At present, however, growth takes place to a large extent on stands of small diameter trees.

Lumber is the principal commercial forest product, but more wood is cut for fuel than for all other purposes combined. Lumber is manufactured chiefly by small portable mills, often operated in conjunction with farming.

Forest increment exceeded commodity drain in 1936 by a substantial margin, resulting in a surplus of 35 percent of the cubic foot increment. This is a favorable situation in view of the understocked condition of the forests.

Prospects

Declining markets for American cotton indicate that farmers in the Piedmont unit must look to other means of livelihood, a problem that forests and forest industries may partly solve. Particularly is this true in the "problem areas" where erosion and soil depletion are outstanding, for in such sections the forest resources often offer the most logical, if not the only, opportunity for new economic development. Even at present the forests of the region can support a somewhat heavier commodity drain and still leave a surplus sufficient to build up the growing stock and improve the quality of future material. Under forest management, moreover, the annual increment can be gradually increased so that a much greater supply of raw materials of a higher quality may eventually become available.

Local markets for cheap, low-grade lumber and fuelwood are being supplied by present production. Expansion of forest industries, therefore, appears limited to two possibilities. First is the opportunity of supplying high quality material to both local and national markets. Although present sawmills can readily expand production if market conditions become favorable, it will be a number of years before the region can produce a sufficient supply of high grade, large diameter trees to afford much active competition on the quality timber market.

A second opportunity is the development of a larger market for low-grade material. Since a large proportion of the timber volume in the unit is in species suitable for pulpwood, the current expansion of the pulp industry in the South appears to offer the most favorable immediate opportunity. Existing mills already draw small quantities of wood from the region, although they are too distant to provide a market for any large quantity of pulpwood. The unit, however, seems to offer an opportunity for the location of a medium sized pulp mill. Not only is an adequate supply of pulpwood available, with a large surplus of growth over drain, but labor and transportation facilities appear favorable.

A prospect for increased use of the forests of the unit is also in better watershed protection. Conservation of the soil and water resources, in view of the erosion problem and its severe effect on numerous hydroelectric developments in the region, is extremely important.

Facilitating measures

If the prospects for an increased income from forests are to be realized, a number of measures are necessary. A new market for low grade material must be developed, either through private initiative or through cooperation of private and governmental agencies. Improved methods of marketing the products of the many small forest owners are also desirable.

Better forest practices are needed on most areas to improve the quality and quantity of timber growth. These include planting abandoned fields, interplanting thin stands, thinning thick young stands, improvement cuttings to remove undesirable species and cull trees and reserve the better trees for future sawlog production, and improved fire control throughout the region. The large acreage of farm woodland offers a good opportunity for carrying out such measures, as labor is available during slack farming periods and the farm fuelwood requirements offer a use for small and cull trees.

Wider adoption of forest improvement measures depends directly upon the degree to which farmers are convinced that such measures are practical. This is a problem requiring cooperative efforts of governmental agencies with farmers. It involves educational work on a broader scale to inform farmers of the most desirable forest practices, research work to develop better forest practices and marketing procedure for the many small producers, and organized fire control throughout the unit, particularly in the 14 counties still without intensive protection in 1938.

G L O S S A R Y

General

Forest survey unit. -- An area of 5 to 10 million acres in which forest, topographic and economic conditions are reasonably homogeneous. The division of a state in this manner facilitates analysis and discussion of the forest situation.

Land-use Classes

Productive forest area. -- Forest land capable of producing timber of commercial quality.

Non-productive forest area. -- Forest land that does not have the qualities necessary for the production of commercial timber.

Cropland. -- Land being used for the production of farm or orchard crops, or showing evidence of having been so used during the preceding 5 years, and still in such condition that it can be easily cultivated.

Abandoned cropland. -- Land formerly cultivated or pastured and now showing distinct signs of having been abandoned for such use.

Pasture. -- Cleared or open land under fence, used primarily for grazing.

Forest Type Groups

Shortleaf pine. -- Stands in which pines make up 25 percent or more of the dominant and co-dominant stems with shortleaf pine predominating.

Loblolly pine. -- Stands in which pines make up 25 percent or more of the dominant and co-dominant stems with loblolly pine predominating.

Virginia pine. -- Stands in which pines make up 25 percent or more of the dominant and co-dominant stems with Virginia pine predominating.

Bottomland hardwoods. -- Stands in which hardwoods make up 75 percent or more of the dominant and co-dominant stems, usually found in river bottoms.

Upland hardwoods. -- Stands on the mountain and upland sites in which hardwoods make up 75 percent or more of the dominant and co-dominant stems.

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Forest Conditions

Sawlog Size

Old growth, uncut. -- Areas with stands composed predominantly of trees of sawtimber size having the characteristics of the original, mature timber of the region and containing at least 1,000 board feet per acre of merchantable species in hardwood types, and 600 board feet per acre in pine types, with less than 10 percent of the volume cut.

Old growth, partly-cut. -- Areas with old growth stands from which 10 percent or more of the volume has been cut, leaving a minimum of 1,000 board feet per acre in the hardwood types, or 600 board feet per acre in the pine types.

Second growth, uncut. -- Areas with stands of second growth having at least 600 board feet per acre in trees of sawlog size, and with less than 10 percent of the sawtimber trees cut.

Second growth, partly-cut. -- Areas with stands of second growth in which 10 percent or more of the sawtimber trees have been cut but with the remaining stand containing 600 or more board feet per acre.

Under Sawlog Size

Second growth. -- Areas with young second growth stands in which the volume of timber in trees of sawtimber size is less than 600 board feet per acre with the remainder of the trees under sawtimber size.

Reproduction. -- Areas not qualifying for any of the above conditions but which have at least 80 well established and well distributed seedlings and sprouts of commercial species per acre.

Clear-cut. -- Cut-over areas having insufficient young growth to qualify for second-growth or reproduction conditions.

Diameters

D.b.h. -- Diameter breast high. The diameter outside the bark of a tree measured at a point $4\frac{1}{2}$ feet above the ground.

Diameter classes. -- All trees were recorded in 2-inch diameter classes, that is, trees measuring 5.0 to 6.9 inches d.b.h. are in the 6-inch diameter class.

Tree Classification

Sawlog-size tree. -- A softwood tree at least 9.0 inches d.b.h., or a hardwood tree at least 13.0 inches d.b.h., with not less than one sound butt log 12 feet long, or with 50 percent of the gross volume of the tree in sound sawtimber.

Under sawlog-size tree. -- A sound softwood tree measuring 5.0 to 8.9 inches d.b.h., a sound hardwood tree measuring 5.0 to 12.9 inches d.b.h.

Cull tree. -- Any tree which, because of form, limbiness, rot, or other defect fails to qualify as a sawlog or under-sawlog-size tree.

Pole or pile tree. -- A pine tree from which a pole or pile could be cut conforming in general to specifications set up by the American Standards Association.

Volume Estimates

Cordwood volume. -- This volume (including bark) is derived from the following sources:

1. The sawlog portion of sawtimber trees.
2. That portion of sawtimber trees not usable as sawlogs but acceptable as cordwood. This includes the upper stems of softwoods, and the upper stems and limbs of hardwoods to a minimum diameter limit of 4 inches outside bark.
3. The sound under-sawlog-size trees at least 5 inches d.b.h. in which the entire stem is included to a variable top diameter not less than 4 inches outside bark.
4. The estimated sound material in cull trees.

Deductions for cull include only the volume in defects which cause the material to be unsuited for cordwood. Sweep and slight crook are not regarded as defects.

Standard cord. -- A stacked pile of round or split wood bolts measuring 4' x 4' x 8' and estimated to contain 90 cubic feet of wood and bark in softwood species, and 80 cubic feet of wood and bark in hardwood species.

Forest Growth

Cubic foot. -- The volume inside bark accruing to all sound trees 5.0 inches d.b.h. and larger, plus the volume in sound trees reaching this specified minimum diameter during the period for which growth is computed.

Board foot. -- The volume accruing to sound softwood trees 9.0 inches d.b.h. and over and hardwood trees 13.0 inches and over, plus the volume in sound trees reaching these respective diameters.